

***OPHIOGOMPHUS SMITHI* N. SP. (ODONATA: GOMPHIDAE)
FROM WISCONSIN AND IOWA**

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Abstract.—*Ophiogomphus smithi*, n. sp., is described and illustrated from 24 males and 15 females (holotype male and allotype female from Wisconsin, Eau Claire County, confluence of South Fork Eau Claire River and Horse Creek, 12 June 1994, K. J. Tennessen). The new species resembles *O. aspersus* Morse; however, the male has shorter proximal lobes on the anterior hamules and the female has occipital horns and a shorter vulvar lamina.

Key Words: Odonata, Gomphidae, new species, Wisconsin, Iowa

Several new taxa of *Ophiogomphus* Selys have been described from North America in the past two decades (Carle 1981, 1982, 1992; Cook and Daigle 1985; Donnelly 1987; Vogt and Smith 1993). The number of species of *Ophiogomphus* in North America is a matter of conjecture, depending on whether several taxa are considered species or subspecies. Based on Needham et al. (2000), the new species described in this paper brings the total to 19. The new species was first discovered in west-central Wisconsin. In the field we independently mistook the specimens for *O. aspersus* Morse, as the male cerci, in lateral view, closely resemble the inflated cerci of that species. Detailed examination of the hamules and several other characters revealed that it was distinct.

***Ophiogomphus smithi* Tennessen and
Vogt, new species
(Figs. 1–6, 10)**

Types.—Holotype ♂: Wisconsin, Eau Claire County, confluence of South Fork Eau Claire River and Horse Creek, 44°43.3'N, 90°59.2'W, 12 June 1994, K. J.

Tennessen (KJT). Deposited in Florida State Collection of Arthropods (FSCA), Gainesville, Florida, USA. Allotype ♀: Same data as holotype; deposited with holotype.

Paratypes (23 ♂, 14 ♀): Wisconsin: Same data as holotype, 3 ♂, 1 ♀, KJT (FSCA); same data, 11 June 1994, 5 ♂, KJT (4 ♂ FSCA, 1 ♂ Coll. National Museum of Natural History, Washington, DC). Eau Claire Co.: Eau Claire River, Co. Rd. D, 44°47.0'N, 91°14.4'W, 12 June 1994, 1 ♂, 4 ♀, 1 pair in cop., KJT (FSCA); same locality, 16 June 1994, 7 ♂, 4 ♀, KJT (5 ♂, 3 ♀ in FSCA, 1 ♂ in Coll. J. J. Daigle, 1 ♂, 1 ♀ in Coll. R. W. Garrison); Eau Claire River, Channey Road Boat Landing, 44°43.7'N, 90°59.3'W, 19 June 1990, 1 ♂, 2 ♀, T. E. Vogt (TEV) (Coll. TEV); same locality, 12 June 1994, 1 ♀, TEV (Coll. TEV); Eau Claire River, Co. Rd. K, 44°48.6'N, 91°16.9'W, 12 June 1994, 1 ♂, TEV (Coll. TEV); Horse Creek near Horse Creek Rd., 44°43.3'N, 90°59.2'W, 12 June 1994, 3 ♂, TEV (Coll. TEV). Jackson Co.: Robinson Creek at Dodge Rd., 44°11.6'N, 90°47.8'W, 19 June 1990, 1 ♂, TEV (Coll.

TEV); Robinson Creek, 1.5 mi. W of Millston, 44°11.4'N, 90°41.4'W, 30 July 1994, 1 ♀, J. J. Daigle (Coll. JJD).

Other specimens examined.—WI, Eau Claire Co.: confluence S Fork Eau Claire River and Horse Creek, 8 June 1993, 3 ♂ (teneral), KJT; Eau Claire River, Co. Rd. D, 16 June 1996, 1 ♂, KJT. Rusk Co.: Chipewa River, Boat Landing Rd. S of Bruce, 45°23.5'N, 91°17.4'W, 23 May 1994 (larva collected and adult ♂ emerged same day), T. C. J. Doolittle & C. Dovichin (Coll. W. A. Smith). Iowa, Buchanan Co.: unnamed stream along Rt. V65, T88N, R10W, Section 31, 19 June 1995, 1 ♂, R. Cruden (University of Iowa Collection).

Etymology.—Named for our colleague and co-discoverer of the species, William A. Smith, biologist, Department of Natural Resources, State of Wisconsin.

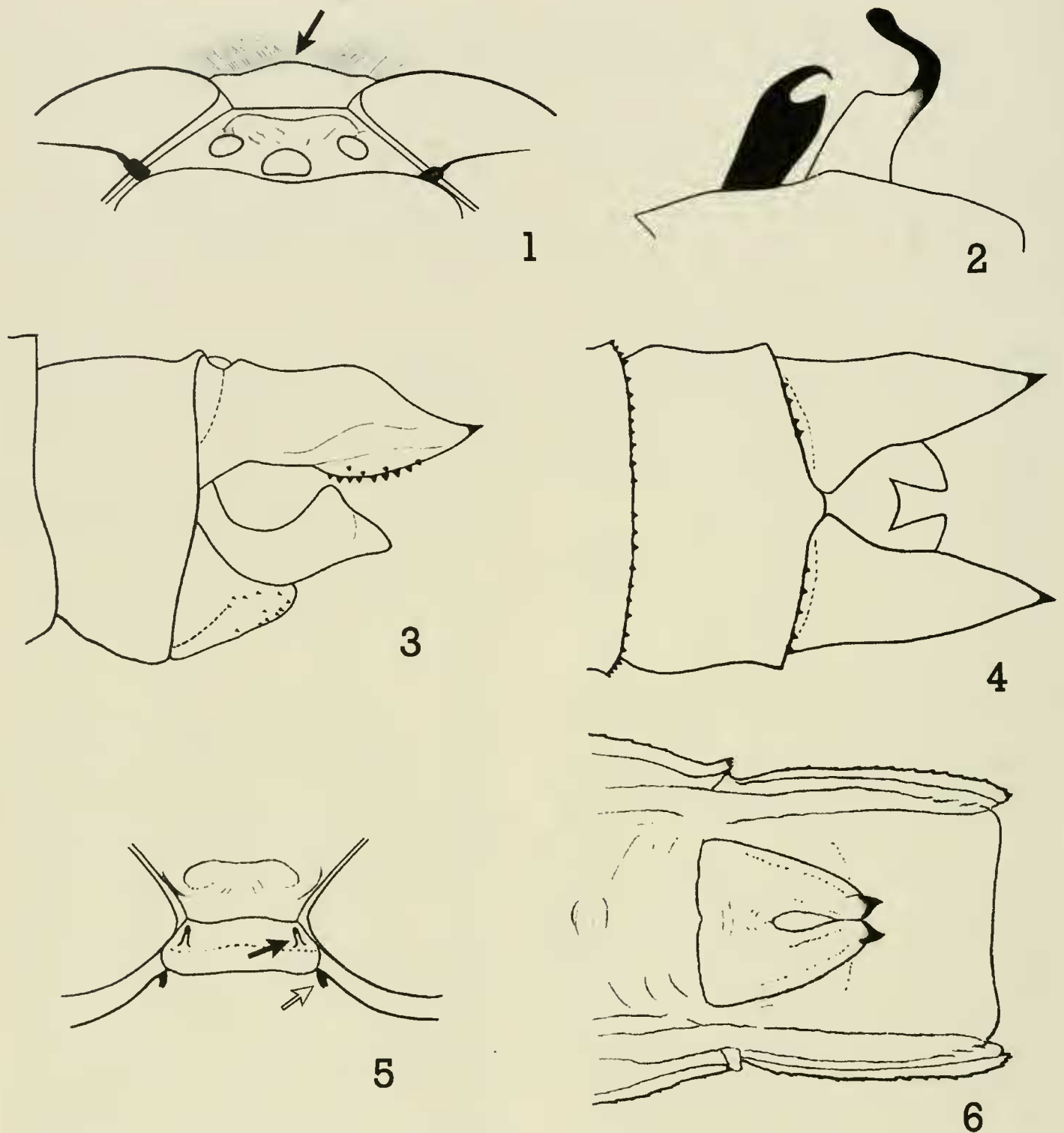
Holotype male.—General color pattern: Thorax light green, abdomen patterned in black and yellow; eyes in life dull dark blue. *Head*: Labium, maxilla, base of mandible, labrum and postclypeus light gray brown; postclypeus green yellow; antefrons green, except basal fourth of horizontal surface dark brown; postfrons (vertex) black around ocelli, tan posterior to postocellar ridge; occiput markedly tumid medially, yellow green, with long, black setae on crest; crest convex in frontal view (Fig. 1), evenly swollen across posterior vertical surface in dorsal view; rear of head black dorsally, mottled with light brown and tan toward cervix and mouthparts.

Thorax: Prothoracic notum mostly brown, middle lobe with a pair of medial yellow green spots, yellow-green laterally; epimeron light brown. Pterothorax mostly light green, with narrow brown stripes as follows: middorsal stripe along dorsal carina, although dorsal edge of carina yellow; episternum 2 (antehumeral) stripe wide anteriorly, extending 0.8 distance to posterior margin of episternum 2, connected at $\frac{3}{4}$ its length to mesopleural (humeral) stripe which extends length of suture but narrowed anteriorly; faint, narrow brown stripe

on inter- and meta-pleural sutures (first and second laterals); metapostepimeron light tan. *Legs*: Coxae tan basally, tan-gray distally; femora mostly yellow tan proximally, black distally; tibiae black except outer surface and lower edge of lateral surface yellow tan; tarsi black except outer surface of first and second segments of hind tarsus yellow tan. *Wings*: Costa yellow, venation dark brown, pterostigma dark brown on dorsal surface, tan on ventral surface; 14 antenodal crossveins in fore wing (fw), 10 in hind wing (hw); 11 postnodal crossveins in fw, 10 in hw.

Abdomen: Segments (S) 1–10 each with dorsolateral, longitudinal dark stripes widened posteriorly and with a broad green yellow middorsal stripe; pale middorsal stripe on S3–9 triangular, tapering posteriorly, extending nearly full length, on S10 oval; S2 with narrow, dark brown stripe ventral to auricle, wider light brown marking posterior to auricle connected to dorsolateral brown stripe; S7–9 with dorsolateral dark stripes slightly paler than on preceding segments, on S10 even paler; all segments tan-gray ventrolaterally; S8–9 each with posterior third of lateroventral flange black; sterna of S3–6 black, 7 brown, 8–10 tan. Anterior hamule dark brown, bifurcate distally, proximal lobe slightly longer than posterior lobe, also more slender and hook-like; space between lobes oval (Figs. 2, 10); posterior hamule green gray proximally, distal slender portion dark brown, recurved and spatulate. Cercus yellow tan, epiproct tan to tan gray; cercus in lateral view thick, dorsal margin convex at midlength, apex sharply acuminate (Fig. 3); cercus in dorsal view separated at midlength by a distance equal to its width (Fig. 4); epiproct in lateral view with high dorsolateral protuberance beyond midlength (Fig. 3); epiproct in dorsal view narrow, dorsolateral protuberances hidden by cerci, base of cleft convex, posterior arms slightly convergent (Fig. 4).

Measurements (mm): Total length 44.5; abdomen length 32.0; hw length 26.2; hw



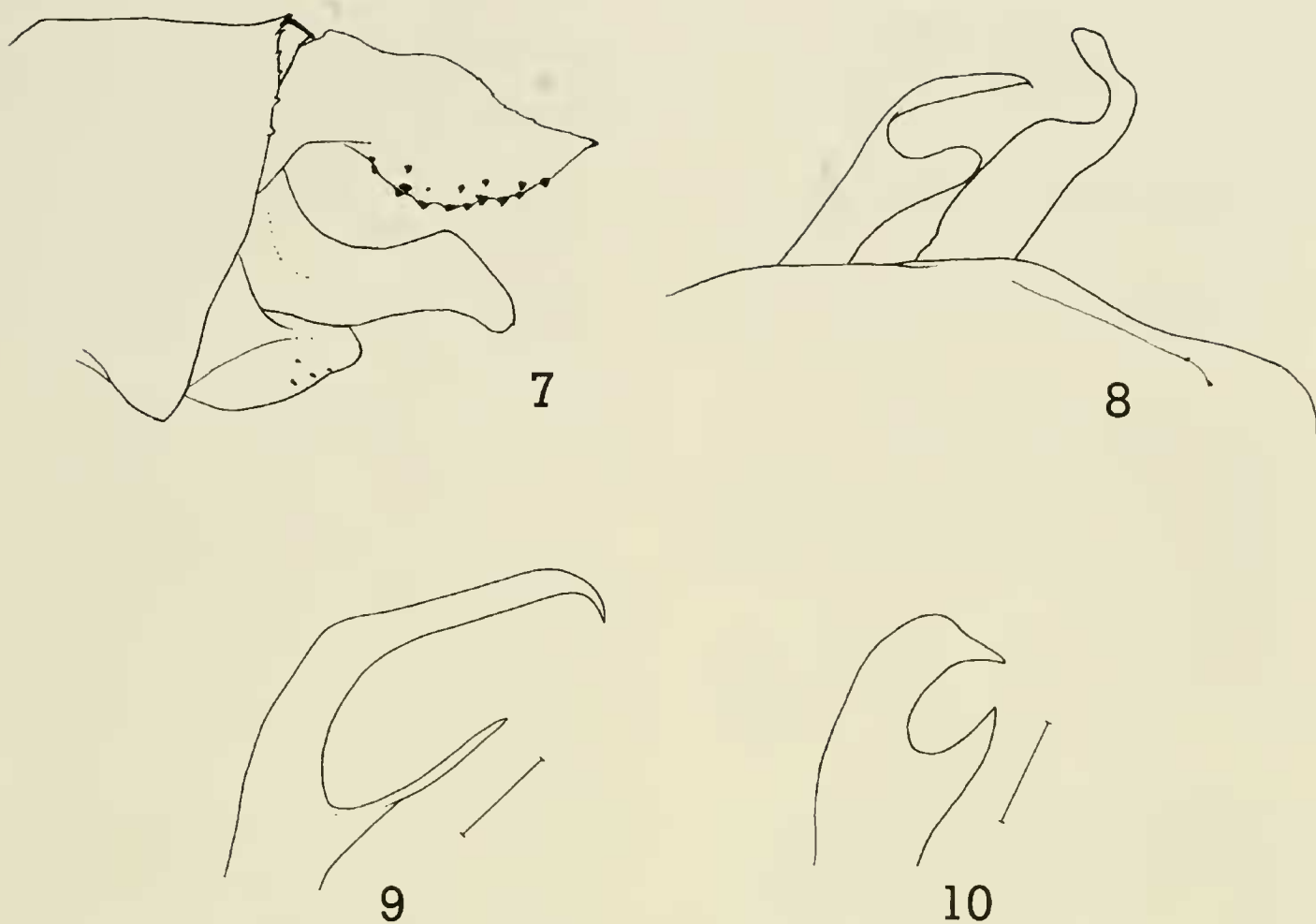
Figs. 1–6. *Ophiogomphus smithi*. 1, Top of head, male frontal view. Arrow indicates convex crest of occiput. 2, Hamules, male lateral view. 3, Anal appendages, male lateral view. 4, Cerci and part of epiproct, male dorsal view. 5, Occiput, female dorsal view. Solid arrow indicates anterior occipital horns, clear arrow indicates posterior occipital horns. 6, Vulvar lamina and sternum 9, ventral view.

pterostigma 2.9; cercus length 1.60; epiproct length 1.23.

Allotype female.—Color pattern similar to male, except eyes dull gray blue in life. *Head*: Color pattern of mouthparts and rest of head as in male; crest of occiput with a slender horn 0.22 mm long at each corner,

spaced 1.37 mm apart, apical third of horns black (Fig. 5); postoccipital horns (on rear of head) shorter (about 0.20 mm), stouter, dark brown; horn on left side with a single acuminate tip, horn on right side more blunt with two small sharp tips.

Thorax: Color pattern of sternites, legs



Figs. 7–10. 7–9, *Ophiogomphus asperses*. 10, *O. smithi*. 7, Anal appendages, male lateral view. 8, Hamules, male lateral view. 9, Right anterior hamule, ventrolateral view. 10, Right anterior hamule, ventrolateral view. Scale = 0.3 mm.

and wings similar to male; 12 antenodal crossveins in fw, 9 in hw; 10 postnodal crossveins in fw, 11 in hw.

Abdomen: Color pattern similar to male, except dorsolateral brown stripe of segment 3 not extending ventrally to vestigial auricle; also, ventrolateral flange of segment 9 black along entire length, and dorsal yellow marking of segment 10 occupying nearly entire dorsum of segment; cercus in lateral view more sharply acuminate than in male. Vulvar lamina mostly yellow tan, tips dark brown; cleft between lobes elongate oval, tips approximated at basal constriction but apices divergent (Fig. 6); tips deflected, visible in lateral view; length of vulvar lamina 0.6 times length of sternum 9.

Measurements (mm): Total length 44.0; abdomen length 31.2; hind wing length 27.6; pterostigma (hw) 3.36; vulvar lamina length 1.27.

Variation in paratypes.—Color pattern was remarkably uniform in the paratypes. In one male and two females, the dark antehumeral stripe was not connected to the dark humeral stripe at its upper end. In several males, the outer surface of the first and second tarsal segments was nearly all black. The abdomen ranged from slightly darker to slightly lighter than in the holotype. **Wing venation:** Males had 11 to 14 antenodal crossveins in fw, 9–10 in hw and 10–12 postnodals in fw, 10–13 in hw (one male had only 8 postnodals in one hw); females had 12 to 14 antenodal crossveins in fw, 9–11 in hw and 10–12 postnodals in fw, 9–13 in hw. The female occipital horns ranged from 0.16–0.30 mm long (in one female the horns were only 0.08 mm long, but the tips appear to be broken off), and the distance between them ranged from 1.28–1.47 mm. In one female, the left occipital horn had a

small sharp black tipped point on its outer side. The postoccipital horns ranged from 0.10–0.24 mm long.

Range in measurements (mm; means in parentheses include holotype and allotype): Males—total length 44.0–47.5 (45.5); abdomen length 31.5–34.5 (32.7); hw length 25.5–27.5 (26.6); hw pterostigma length 2.9–3.3 (3.1). Cercus length 1.56–1.78 (1.69); epiproct length 1.19–1.35 (1.26). Females—total length 43.5–46.5 (45.0); abdomen length 31.0–33.5 (32.1); hw length 27.5–29.5 (28.5); hw pterostigma length 3.3–3.9 (3.6); vulvar lamina length 1.15–1.39 (1.31).

Diagnosis.—TEV examined Morse's type series of *O. aspersus* (1895) in the Museum of Comparative Zoology, Cambridge, in March 2001. The syntype series consists of 5 specimens (2 ♂, 3 ♀); 1 ♂ and 1 ♀ each bear a label with the word "Type" in red ink. All are from Wellesley, and probably all are from Massachusetts, but the collectors, S. W. Denton and S. F. Denton, wrote "MA" on only some of the data labels. Examination of these specimens confirmed that *O. aspersus* is correctly diagnosed in recent taxonomic works. Males of *Ophiogomphus smithi* key to *O. aspersus* in couplet 7 of Needham et al. (2000) based on the inflated male cerci. However, the second character in that couplet ("apical processes of anterior hamuli nearly twice as long as apical processes of posterior hamuli") does not fit *O. smithi* (note that it is the proximal process, or lobe, of the anterior hamule that is longer than the apical process of the posterior hamule in *O. aspersus*, not the apical process as stated in couplet 7). In Walker (1958), males of *O. smithi* key to couplet 6 where they conflict in the two characters given (postocellar ridge is not sinuate but apices of cerci are acute). In Walker (1958), females key to *O. occidentis* Hagen, except for the designation of "western." Several structural characters serve to separate males of *O. smithi* from *O. aspersus*: 1) In lateral view, the cerci of *O. aspersus* have a markedly con-

vex ventral margin (Fig. 7) compared to the slightly convex margin of *O. smithi* (Fig. 3); 2) The superoexternal tooth of the *O. aspersus* epiproct is only slightly produced and the deflected tip is elongate (Fig. 7), whereas in *O. smithi* the superoexternal tooth is greatly produced and the deflected tip is shorter (Fig. 3). In *O. aspersus*, the proximal lobe of each anterior hamule is as long as the slender apical lobe of the posterior hamule (Fig. 8). In *O. smithi*, this lobe is about half as long as the apical lobe of the posterior hamule (Fig. 2).

The gap separating the apical lobes of the epiproct in dorsal (or ventral) view is variable in *O. aspersus*, the lobes themselves being parallel to slightly convergent and their inner margins straight to slightly curved. We have not found any reliable character for separating the two species based on a dorsal or ventral view of the epiproct. The abdomen of male *O. aspersus* ($n = 7$) was slightly longer (34.6–35.1 mm) than in *O. smithi* (31.5–34.5 mm), and the epiproct was slightly longer (1.39–1.52 mm vs. 1.19–1.35 mm).

The most striking difference between *O. smithi* and *O. aspersus* exists in the anterior hamules. In *O. aspersus*, the proximal lobe of the anterior hamule is slender for its whole length and terminates in a curved hook in ventrolateral view (Fig. 9), whereas in *O. smithi* it is short and wide and terminates in a straight abrupt point (Fig. 10). The anterior hamules of *O. smithi* are similar to those of two other species within its range, *O. rupinsulensis* (Walsh) and *O. colubrinus* Selys. These species are easily separated from *O. smithi* as follows: *O. rupinsulensis* lacks a definite brown middorsal thoracic stripe and the cerci in lateral view are parallel-sided and blunt; in *O. colubrinus*, the cerci are not inflated, and the epiproct is as long as the cerci (see Needham et al. 2000).

In females, the vulvar lamina of *O. aspersus* extends about 0.75 the length of sternum 9 versus 0.6–0.66 in *O. smithi* (one of the shortest in the genus in eastern North

America). In *O. aspersus* females, occipital horns vary from absent to very small and widely spaced; postoccipital horns (0.25–0.43 mm long) were present in the few specimens we examined.

Two color pattern differences that appear to hold for both sexes are: 1) The dorsal yellow spots on abdominal segments 7–9 are full length in *O. smithi* whereas they do not extend to the apex of the segment in *O. aspersus*; 2) the external surfaces of the tibiae are usually yellow in *O. smithi* versus black in *O. aspersus*.

Distribution and habitat.—We examined specimens of *Ophiogomphus smithi* from three counties in Wisconsin (Eau Claire, Jackson, and Rusk) and one county in Iowa (Buchanan). The streams from which these specimens were collected are medium sized with predominantly sandy substrates. With this in mind, Dunkle (2000) gave it the common name “Sand Snaketail.” Since we made our collections, W. A. Smith (personal communication) has found additional localities where the habitat is more variable than purely sand-bottomed streams. He will be describing the larva with more information on habitat in an upcoming paper.

Flight dates we recorded are May 23 to July 30; most adults were collected in June.

The record for *O. aspersus* in Wisconsin (Ries 1969) was based on a single specimen collected by P. D. Harwood in Siren, Burnett Co. Before his death, Dr. Harwood told us that he loaned the specimen to a colleague in Canada, but he could not remember his name. We have been unable to find the Harwood specimen, and can only assume that it was *O. smithi*. W. A. Smith has examined larvae of *O. smithi* from the Clam River approximately 7 km N of Siren (personal communication). *Ophiogomphus aspersus* was reported for Michigan based on a single female from Gogebic Co. (Kormondy 1958). KJT examined this specimen (housed in the University of Michigan Collection) and determined it to be *O. carolus* Needham. These findings indicate that the range of *O. aspersus* is Appalachian, and

includes NB, NS and QC in Canada and CT, KY, ME, MA, NH, NJ, NC, NY, RI, VA, and VT in the United States. The known western limit in the northern part of the *O. aspersus* range is at Nominungue, Canada, 75°W longitude (Walker 1958), whereas in the midsouth region it is Green Co., KY (Cook 1951) at approximately 85.7°W longitude.

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LITERATURE CITED

- Carle, F. A. 1981. A new species of *Ophiogomphus* from eastern North America, with a key to the regional species (Anisoptera: Gomphidae). *Odonatologica* 10: 271–278.
- . 1982. *Ophiogomphus incurvatus*: A new name for *Ophiogomphus carolinus* Hagen (Odonata: Gomphidae). *Annals of the Entomological Society of America* 75: 335–339.
- . 1992. *Ophiogomphus (Ophionurus) australis* spec. nov. from the Gulf Coast of Louisiana, with larval and adult keys to American *Ophiogomphus* (Anisoptera: Gomphidae). *Odonatologica* 21: 141–152.
- Cook, C. 1951. Some new dragonfly records for Kentucky (Odonata). *Entomological News* 62: 181–188.
- Cook, C. and J. J. Daigle. 1985. *Ophiogomphus westfalli* spec. nov. from the Ozark region of Arkansas and Missouri, with a key to the *Ophiogomphus* species of eastern North America (Anisoptera: Gomphidae). *Odonatologica* 14: 89–99.
- Donnelly, T. W. 1987. Structural variation of *Ophiogomphus mainensis*: Description of a new subspecies and relationship to sibling species (Odonata: Gomphidae). *Proceedings of the Entomological Society of Washington* 89: 205–214.
- Dunkle, S. W. 2000. *Dragonflies Through Binoculars: A Field Guide to Dragonflies of North America*. Oxford Univ. Press, New York. 266 pp.
- Kormondy, E. J. 1958. Catalogue of the Odonata of Michigan. *Miscellaneous Publications of the Museum of Zoology, University of Michigan* 104: 1–43.
- Morse, A. P. 1895. New North American Odonata. *Psyche* 7: 207–211.

- Needham, J. G., M. J. Westfall, Jr., and M. L. May. 2000. Dragonflies of North America. Scientific Publishers, Gainesville. 939 pp.
- Ries, M. D. 1969. Odonata new to the Wisconsin state list. Michigan Entomologist 2: 22–27.
- Vogt, T. E. and W. A. Smith. 1993. *Ophiogomphus susbehcha* spec. nov. from north central United States. Odonatologica 22: 503–509.
- Walker, E. M. 1958. The Odonata of Canada and Alaska, Vol. 2, Part III: The Anisoptera-Four families. University of Toronto Press, 318 pp.